Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

reef which extends about 2 miles from Pleinmont Point), and the extremity of the island of Lihou. It may have passed beyond the Bays of La Perelle, Vazon, Cobo, the north-western limit of Clos du Valle, including the whole extent of the Braye." The author of the passage just quoted, says also in the 'Archæological Journal,' when speaking of a cromlech at L'Ancresse Bay, on the north of Guernsey, as follows:—"At the period it was constructed, the sea was at a greater distance from the site of the hill than at present, for the whole neighbourhood bears marks of the inroads of that element: the near approach of the sandy hills around it was caused by those events which have so materially changed the coast of these islands, as well as that of the opposite continent."

So far the eminent authority quoted and the present writer are agreed. But it is submitted to the reader that the proposition contained in the following short quotation from the same eminent authority is inadmissible, because it is impossible. He says "that the whole (of the submarine peat and trees) was the produce of a low district which was protected from the power of the Atlantic wave, by rocks and silted materials at a certain distance from the present coast-line."

Now that supposed mass of rocks and silted materials must have been watertight, else the sea-water would have percolated through it, and have made the supposed low district a lake; and if so the trees could not have grown. On the other hand, if the supposed natural embankment was watertight, we are met by another insuperable difficulty derived from the following considerations. Guernsey consists of igneous rocks like the Isle of Bute, where rain gaugings have been taken, and the produce of the streams has been measured all the year round. The result was found to be that a little more than half the annual rain flowed off by the brooks and streams. Applying this fact to Guernsey, where the annual rainfall averages 35 inches, we shall have an annual "flow" of about half a yard in depth. And assuming the most probable situations for the supposed low district and natural embankment of "rocks and silted materials," the latter would have extended along a line parallel to, and at a little distance off the present north-west coast of Guernsey; such line being at present chiefly occupied by rocks. The portion of sea within would have had an average breadth of about half a mile. It would follow then that the total gathering ground comprised between the "watershed" line, or summit ridge of the hills of Guernsey, and the "natural embankment" would comprise 9,934 acres; and taken at half a yard deep, would yield annually about 24 millions of cubic yards of water. This would fill the assumed low district, taken at half a mile wide, to the average depth of 9 feet 3 inches annually, and of course in a few years have been fatal to the trees; or, rather, it would have been impossible for them ever to have grown there. The Low District theory ought therefore to be abandoned.

Another way of arriving at a similar conclusion, but without quantities, is to remember that there are about half-a-dozen brooks perpetually running day and night into the supposed low district, which would be sure to fill it and kill the trees.

5. *Further observations on the Temperature, Specific Gravity, &c., of the Seas between England and India, supplementary to the Memoir published in the 'Journal of the Royal Geographical Society,'* vol. xxxv., p. 147. By Henry Toynbee, F.R.A.S., and F.R.G.S., Master Mariner.

Before my leaving England last August, Commander George, R.N., kindly undertook to extract data from the Board of Trade logs with which to form a chart that should illustrate my paper 'On the Specific Gravity, Temperature and Currents of the Seas passed through during Voyages from England to India,' &c., &c.

I have been deeply interested by Commander George's chart, on which he has expended so much successful labour; it also illustrates very forcibly a fact which I have often remarked, viz., that on the homeward-bound route, just before coming to the eastern edge of the Agulhas Bank, the current is almost invariably easterly, although three or four degrees further to the west, it runs strongly to the s.w., just as if the Agulhas current acted like a wedge and drove the water on its eastern edge in a direction at right angles to its own course.

It would be very interesting to know if the sea in close contact with the land near Natal is warm or cold, whether it belongs to the cold, comparatively still water which exists *on* the Agulhas Bank, or whether the Mozambique current, with its warm water, skirts along the East Coast of Africa without an intervening cushion of cold water. My impression is that cooler water exists close to the land, at least, near the south-east coast of Africa.

Having the rough copies of the above-named logs, I went into the subject of the temperature of the sea in high southern latitudes more carefully than before; the result of the enquiry is contained in the accompanying chart or diagram,* on which I made the following remarks:—

This chart gives six times as much space to a degree of latitude as to a degree of longitude; by this means a separate line in each degree of latitude is devoted to each of six voyages, the object being to show what temperature was found in the same degree of latitude and longitude each year. The result is striking, for it will be noticed that in nearly the same spot, at the same season of different years, we found water differing 12° in its temperature; for instance, in 40° s. lat., and 23° E. long., in August, 1860, the surface temperature was 67°, whereas in the same place in August, 1863, it was 55°. It does seem as if the cold water were driven under the warm water and forced to the surface in spots here and there. A good self-registering maximum and minimum deep-sea thermometer would give some most interesting results in these parts of the sea.

The style of the chart which I now send distorts the sea most deceptively in the direction of the latitude, but it was the only method I could devise for producing the requisite accuracy. It had been my intention to give a rightly proportioned chart with the mean of temperatures in each degree of longitude in its proper degree of latitude, but this would not show the variations of temperature in the same spot at the same season.

The temperature of warm water is entered in red ink, that of cold water in black, above the temperature is written the current in the last 24 hours, where it was known; and below it the specific gravity. The first five of these voyages enter this part of the sea the latter end of August, the sixth on the 1st of October; they are for the years 1860 to 1865 inclusively. My senior midshipman, Mr. Ridley, has made himself very useful in extracting the data from the logs.

Commencing in 35° s., and 20° w., and sailing to the south-east, we found that the surface water gradually decreased in temperature from 60° to 47°. This cold water is in about 40° s., and extends from the meridian of Greenwich to 14° E. The gravity is from 1·028 to 1·027, decreasing a little as we come to the south-east. The current, especially in 36° and 37° s., from 16° w., to the meridian of Greenwich, is northerly. In October, 1865, for three consecutive days, it was N. 7° E., N. 7° W., and N. 17° E., 16 miles in the 24 hours each day, and the specific gravity was 1·0265.

---

* This chart may be seen in the Map-Room of the Society, on application to the Curator.—Ed.

In 39° s. and 15° E., we invariably came suddenly upon warm water at a temperature of 60° to 63°, which increased to 67° in 19° E. to 23° E.: the specific gravity was generally 1·027 in the warm water, but only 1·0265 in that at a temperature of 67°. In 38° s. the warm water commenced a little further west, and in 40° s. a little further east. In 41° s. and 42° s. warm water was met with in 50° E. to 60° E., all of these differences showing that the course of the warm water tends to the south-eastward.

From 15° E. to 47° E. the temperature was very variable, seldom below 55°, or above 63°, but it would change from one of these to the other in a distance of 15 miles or less.

In 40° s. and 50° E. we invariably came upon a patch of cold water, sometimes down to 44°, which alternates within a few miles with water 15° warmer. In 40° s. this patch of cold water extends for about 10 or 12 degrees of longitude, and it seems to be surrounded by warm water on all sides, except the south-west.

From 40° s. and 53° E., steering to the north-eastward, we find the surface temperature to be variable; in 39° s. it is from 53° to 59°, still showing the effect of the warm current; in 38° s. it is 55°; in 37° s. it is from 54° to 56°; in 36° s. it is from 56° to 57°; and in 35° s. it is from 55° to 58°. Comparing these temperatures with those to the westward of 15° E., (the spot where the warm water is first experienced), we find that in 39° s. it is from 5° to 9° warmer to the eastward than to the westward; in 38° s. about 2° warmer to the eastward; in 37° s. about the same temperature in both longitudes passed through; in 36° s. about the same temperature; and in 35° s. about 2° colder to the eastward than in the same latitude in 19° W. longitude.

The current from the time we get the warm water is generally a little south of east in direction, and about 20 or 30 miles in 24 hours, it seems to be as strong in the cold as in the hot water; once it was as much as 80 miles in 24 hours. The sea is very high where these hot and cold waters meet; my first experience of it, as commander of a ship, was in 1848, when it jumped our best chronometer out of its stand, and I found it lying on the deck; this first led me to rate chronometers by lunars, which I find is quite feasible to ordinary observers, who may get an error right to 20 seconds, and a daily rate which shall be right to less than one second.

With regard to the warm water, the general impression given is that the great Mozambique or Agulhas current recurves to the south-eastward after running for some distance to the south-west and south, and that its western limit in 39° s. is 15° E. longitude, and its eastern limit in 40° s. is 50° E. Steering, as we do, to the north-east from 40° s. and 56° E., we are not able to follow the route of this current, which most probably continues to travel to the south-eastward, for one can well imagine that this immense body of warm water must have somewhat the same influence on climates to the southward as our Gulf-stream has upon the coasts of Europe. The logs of Australian ships would throw a little more light on this subject, as proved by the quotation from the log of the *Champion of the Seas* in my last paper: unfortunately, the longitude of that ship was not given by Mr. Towson, where he remarks on her having the surface water of the sea 44° in latitude 58·30° s., and expected ice, *i. e.* nearly 4° warmer than what we had experienced when nearly 1000 miles nearer the equator. I am inclined to think it must have been south-east of the Cape of Good Hope.

In both warm and cold water the specific gravity was about 1·027, slightly decreasing when it was very warm or very cold.

The peculiar way in which the hot and cold waters alternate is very puzzling. I did hope to try some temperatures at various depths, to detect if the warm water were comparatively on the surface, but the deep-sea thermometer broke down, so that this work remains to be done.

On the homeward passage we had the same cold water on soundings to the westward of Cape Agulhas; standing in towards the land near Birkenhead Rock (Danger Point), March 19th, 1866, the surface temperature decreased from 67° to 60° in 20 miles, the last temperature was taken within 5 miles of the land (proving that in some places the thermometer is a useful aid to the navigator in thick weather); the specific gravity here was 1·027, whereas it was only 1·0245 in the Mozambique current where the temperature was 76°. To the eastward and south eastward of the Agulhas bank, this warm water seems to increase its specific gravity very quickly as it travels to the south, for outward-bound in 40° s. it is 1·0265 to 1·027; it is also worthy of remark that in the middle of March we found the specific gravity of this current to be 1·0245, whereas in the middle of February it was 1·0255: this difference is probably due to a month more of the rainy season having existed in the Southern Indian Ocean in March than in February, and it is probable that a corresponding difference exists in 40° s. latitude; here again other logs will be useful.

In Table Bay, March 20th, 1866, the surface was 54°; about 15 miles north-west from Robben Island it was 58°, and the current running strongly to the northward. In 32° 25′ s., and 15° 44′ E., about 152 miles N.W. by W. (true) from Table Bay the temperature of the surface was 64°, and the specific gravity 1·0262; the sea gradually grew warmer as we increased our distance from the land: it seems as if the bank of soundings brought to the surface cold heavy water from a great depth, as the surface water cools so quickly on approaching the land. Can there be somewhat the same cause to throw up the cold water amongst the warm in higher latitudes? Probably an under current and rough bottom might do something of this kind, causing the sudden changes met with in 40° s.

A remark made at the Geographical Society (I think by Mr. Galton) when the last paper was read, in which that gentleman spoke of the peculiar coldness felt on the coast to the northward of Table Bay, together with what we read of the great dryness of Namaqualand and the Kalihari Desert further to the eastward, led me to put together the facts deduced from my paper printed by our Society, and another printed by the Royal Society 'On the Normal Circulation and Weight of the Atmosphere in the North and South Atlantics,' &c. &c. Our logs show that after passing to the westward of the Cape, and before getting the south-east trades, the wind is almost invariably from west to south-west and the barometer comparatively low.

This south-east wind and lower barometer are most likely due to the rarefaction of the air over the dry and heated lands above mentioned, and the extreme scarcity of rain in these parts may be accounted for by the sea-breeze having to pass over so cold a sea that its capacity for moisture is greatly increased when it comes in contact with these heated lands, so that, instead of giving out rain, it is turned into a moisture-seeking wind.

Part of this letter seems to be a repetition of some of my last year's paper; but, having carefully reconsidered these data, I thought it well to lay the result before our Society.

The late Professor Forchhammer's deeply interesting paper, 'On the Composition of Sea-water in the different parts of the Ocean,' alludes to its temperature and specific gravity; having observed them for so many years, I am led to make the following remarks:—

The weight and saltness of the surface water of the ocean in any particular latitude, more especially in the tropics, seem to depend upon the season of the year, and the position of the spot in relation to the cloudy, rainy doldrum which travels north and south, but always exists between the trade winds.

Rough as our method of observing the specific gravity of the sea may be (it is done in a sheltered place in a very full bucket of water) it warns us, when many miles away under blue sky and fine weather, of our approach to these rainy doldrums, decreasing gradually from 1·026 to 1·022, the cloudy sky which exists over this zone of the sea checks evaporation, which, in addition to the large amount of rain which falls, causes a ridge of higher fresher water in the sea, which runs over to the north and south of the ridge, carrying with it a line of foam, in which we frequently see sickly-looking Physalidæ and Velellæ which seem to be suffering frrom the fresher state of the water. Specimens from this surface water would hardly give fair results and (so far as I can remember) the Professor does not allude to these rains, but only to the effects of rivers.

In another place he remarks upon the warm fresh water from the African rivers forming the equatorial current in the Atlantic, whereas we found the temperature of this current to be 69·9° in August, 1863, the sky blue and cloudless, the atmosphere damp and hazy from its contact with this cold water, and its specific gravity was 1·0255, higher than water to the north of it, surely this cold water must have had a Polar origin. Returning home on our last voyage, April, 1866, in the equatorial doldrum between 1° and 5° N. we had a warm current of light water setting to the westward 40 miles in 24 hours, temperature 83°, specific gravity 1·0228; we had much heavy rain with it.

The Gulf of Guinea and Bight of Benin must in some parts be a perfect jumble of heaped-up waters from the meeting of currents, for an easterly current sets into them by Cape Palmas (this we invariably detected as we passed 7° N. outward-bound in August and September), then a northerly current seems to come into them from the southward, and they receive water from the African rivers and from rain: these numerous and abundant sources may well keep up a strong equatorial current.

I have already remarked upon the cold heavy water met with March 19th, 1866, near Danger Point, South Africa: the great specific gravity of this water seems to differ from Professor Forchhammer's experience of Polar currents.